

**REMARKS**

Claims 1-34 are in the application, with Claims 1-18 and 23-33 having been withdrawn from consideration.

Claims 19-22 and 34 remain in active prosecution, with Claims 19 and 20 being independent.

Claims 19-22 and 34 continue to stand rejected.

Applicants turn to the substance of the Action.

**Sections 102(b) and 103(a) Rejections**

Claims 19-22 and 34 continue to stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by or in the alternative under 35 U.S.C. § 103(a) as allegedly being obvious over Wang or Fock for the reasons given at pages 2-3 of the Action.

Applicants continue to traverse the Sections 102(b) and 103(a) rejections.

As the Examiner is aware, the present invention as defined by Claim 19 is directed to and claims a method to improve the fracture toughness of a curable epoxy-based adhesive composition.

The method includes the steps of adding to the adhesive composition an effective amount of a toughening agent comprising a curable epoxy-extended polyacrylate

having at least one  $\beta$ -hydroxyester linkage. The polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid.

And as defined by Claim 20 the invention is directed to and claims a curable adhesive formulation comprising a curable epoxy resin, a curing agent, and at least one toughening agent comprising a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage. The polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid. Optionally, the composition includes a filler.

Wang describes polymers with structures and molecular weights distinctly different to those defined herein. The epoxy-extended polyacrylates used to improve fracture toughness in the inventive curable epoxy-based

adhesive compositions have epoxy end groups linked to a polyacrylate fragment through a  $\beta$ -hydroxyester linkage formed in the polyesterification step. The epoxy end groups result in a curable polyacrylate toughener. See e.g. specification, page 5, paragraph [0021] and Example 1.

The Wang polymers instead have epoxy functional groups linked to the polyacrylate fragments through a hydrocarbon linkage.

Wang's ETPnBA epoxy polymers, described at page 793, first column, second paragraph and cited by the Examiner, do not contain epoxide groups linked through  $\beta$ -hydroxyester functions. Those polymers instead contain tertiary amine and semipinacol linking groups, synthesized in a photoinduced polymerization reaction. Thus, the Examiner's arguments in this regard based upon molecular weight are misplaced.

Wang's polymers have molecular weights in the range of 26,000-40,000, which as noted are greater than 2.5 times (and up to 4 times) that of the curable epoxy-extended polyacrylates used herein, which by the definition of the two independent claims are in the range of about 1,000 up to about 10,000.

The  $\beta$ -hydroxyester linkage found in the inventive curable epoxy-extended polyacrylates also adds polarity to the polymer, something not found in Wang's polymer. This added polarity is beneficial in promoting adhesion of the toughening agent to a filler, if used, and to the substrate surfaces. The added polarity also improves compatibility between the inventive toughening agent and uncured epoxy monomers with which the toughening agent is intended to be used.

This latter point distinguishes from the use to which Fock intends to place his materials.

Fock is directed to and claims a method for flexibilizing epoxide resins comprising adding to the epoxide resins prior to curing, copolymers obtained by the polymerization of A<sub>1</sub>) 40 to 87 weight percent of one or more alkyl esters of acrylic or methacrylic acid having 1 to 8 carbon atoms in the alkyl radical, A<sub>2</sub>) 10 to 40 weight percent of vinyl acetate or acrylonitrile, A<sub>3</sub>) 1 to 20 weight percent of acrylic, methacrylic or itaconic acid, A<sub>4</sub>) 1 to 5 weight percent of glycidyl acrylate or glycidyl methacrylate, and A<sub>5</sub>) 0 to 35 weight percent of acrylic or vinyl monomers which are different from the monomers A<sub>1</sub> to

groups and has at least one carboxyl group, where the copolymers having an average molecular weight of 1,000 to 3,000, as measured in a vapor pressure osometer, in amounts such that 1 to 60 mole percent of the epoxide groups of the epoxide resins react with the carboxyl groups of the copolymer.

The use of vinyl acetate or acrylonitrile creates a polymer that does not flow and is unsuitable for capillary flow underfill applications.

As can be seen from the manner by which the inventive epoxy-extended polyacrylates are made, the inventive polyacrylates are not the copolymers described by Fock. More specifically, Fock requires a copolymer made from alkyl esters of acrylic or methacrylic acid, vinyl acetate or acrylonitrile, glycidyl acrylate or glycidyl methacrylate, and acrylic or vinyl monomers. Applicants' epoxy-extended polyacrylates are not so defined.

Fock's acrylates, like those of Wang, are unsuitable for use to improve fracture toughness of adhesive composition.

That is, Fock's material is for use as a flexibilizer, which will render the product with which the flexibilizer is to be used to be more peel resistant. In

flexibilizer is to be used to be more peel resistant. In contrast, the toughening agents of the present invention improve fracture toughness in epoxy-based compositions, which may or may not affect the peel resistance. However, Fock's material would not improve fracture toughness.

Fock as noted above is directed to flexibilizing, which often does not correlate with toughness. Peel strength increases with increased flexibility; fracture toughness does not necessarily improve. Rather, just the opposite is ordinarily observed. A more flexible material is often softer, which tends not to provide improved toughness.

Thus, Fock is directed to a different end use altogether, let alone that which is recited in independent Claim 19 -- that is, a method of improving fracture toughness.

Wang also describes the photochemical synthesis of CTPnBA and the use of such materials as curing agents of epoxy resins (Table IV and p 790, column 2, first paragraph). Upon curing, these CTPnBA yield polymers containing  $\beta$ -hydroxyester linking groups, as the Examiner suggests.

However, those polymer products are cured (not curable), insoluble, crosslinked network polymers (see Wang, sections on mechanical properties and morphology), rather than curable epoxy-extended polyacrylates. As such, Wang's polymers are unsuitable for use to improve fracture toughness of adhesive composition.

In sum, Wang does not disclose, teach or suggest curable epoxy-extended polyacrylates having at least one  $\beta$ -hydroxyester.

It is well settled that in order to be an effective anticipatory reference, a single document must disclose each and every recitation of a claim under review. Failing such precise disclosure, rejections under Section 102 are improper. Here, neither Wang nor Fock possesses such disclosure.

For instance, neither Wang nor Fock speaks to improving fracture toughness (rather they each speak to flexibilizing) or to a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage.

Therefore, as neither Wang nor Fock discloses each and every recitation of the claims under review, the Section 102(b) rejections based thereon cannot stand and as

such Applicants request reconsideration and withdrawal thereof.

As regards the Section 103 rejection over each of Wang and Fock, epoxy-based adhesive compositions containing either Wang's or Fock's polymers are unlikely to have adequate capillary flow for microelectronic assembly applications, such as underfill applications. This is so because the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000 and an average functionality of at least about 2.2. The molecular weight ranges are discussed and contrasted above. The average functionality confers branching to the polyacrylate. The branching translates into a lower viscosity, which means that the polyacrylate is more dispensable or flowable. Neither Wang nor Fock discloses, teaches or suggests a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage having such requirements.

Applicants' claimed curable epoxy-extended polyacrylates having at least one  $\beta$ -hydroxyester linkage provide both improved fracture toughness and capillary flow properties and are thus distinguished over each of Wang and



extended polyacrylates having at least one  $\beta$ -hydroxyester linkage have improved fracture toughness, in terms of a  $G_c$  exceeding 2 lb/inch (Example 2) and capillary flow less than or equal 180 seconds (Example 3).

The end use to which each of Wang's and Fock's polymers are placed are as or in epoxy prepreg formulations, as contrasted to those of the present invention, which are as or in underfill adhesives. Prepregs are molded composites prepared by autoclave or pressclave methods and used as support materials for printed circuits. They provide no adhesive function in the sense of component assembly. There is no similarity in the end use application of epoxy resins for moldings and the adhesive assembly of micro electronic component.

To conclude that the pending claims are obvious over either Wang or Fock as the Examiner has, could only have come about from the use of impermissible hindsight. That is, the Examiner must have used the subject application as a basis for filling in the gaps of the two cited documents of record. Hindsight as the Examiner knows can find no place in the examination of applications for Letters Patent.

Application No. 10/692,935  
Amendment After Final Rejection dated May 11, 2006  
Office Action dated March 13, 2006

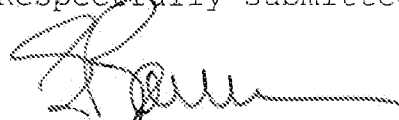
can find no place in the examination of applications for  
Letters Patent.

Based on the above, Applicants submit the  
application is in condition for allowance.

This paper in any event represents an earnest  
attempt at advancing prosecution on the merits, and thus  
respectfully submits that entry thereof is proper and at a  
minimum helps to focus the issues for appeal.

Applicants' undersigned attorney may be reached  
by telephone at (860) 571-5001, by facsimile at (860) 571-  
5028 or by e-mail at [steve.bauman@us.henkel.com](mailto:steve.bauman@us.henkel.com). All  
correspondence should be directed to the address given  
below.

Respectfully submitted,



---

Steven C. Bauman  
Attorney for Applicants  
Registration No. 33,832

HENKEL CORPORATION  
Legal Department  
1001 Trout Brook Crossing  
Rocky Hill, Connecticut 06067  
Customer No. 31217